OLDSQUAWS NESTING IN ASSOCIATION WITH ARCTIC TERNS AT CHURCHILL, MANITOBA

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The tendency for the Oldsquaw (*Clangula hyemalis*) to nest in close association with the Arctic Tern (*Sterna paradisaea*) has been noted in several geographic regions, including Alaska (Bailey, 1925, 1943), Southampton Island (Sutton, 1932), Greenland (Salomonsen, *in* Larson, 1960), and Spitsbergen (Lovenskiold, 1954; Burton and Thurston, 1959). Taverner and Sutton (1934) reported both species as common breeders along the west coast of Hudson Bay, near Churchill, Manitoba, but did not refer explicitly to association of nests of the two species. That such associations do occur in this region, however, is indicated by the observations of Twomey (*in* Taverner and Sutton, 1934) that populations of both species nested on a single small offshore island. Hawksley (1957:66) states that "the Old-squaw is commonly found nesting with Arctic Terns in North America," and implies that such associations occur at Churchill, but does not indicate the locations or extent of the association in this region. Evidence that close associations between nests of Oldsquaw and Arctic Tern are common on the mainland at Churchill, and particularly on small islands in fresh-water ponds, is presented below.

Larson (1960) has suggested that nest associations such as those mentioned above are commensal, the Oldsquaw deriving a degree of protection from potential nest predators as a result of the well-developed nest defense behavior of the Arctic Tern. The interpretation that protection from nest predators is derived by the Oldsquaw or other species, notably the eider (*Somateria*) and brant (*Branta bernicla*; *B. nigricans*) when they nest in association with Arctic Terns, has also been advanced by several other investigators, including Lovenskiold (1954), Gudmundsson (1956), Burton and Thurston (1959), Hilden (1965), and Cooch (1967). Koskimies (1957) and Vermeer (1968) have advanced the further hypothesis that imprinting of ducklings to gulls or terns nesting in the same vicinity may constitute the proximate cause of these and other similar associations.

The hypothesis that nest associations between Arctic Terns and Oldsquaws are commensal relationships that develop locally as a result of imprinting does not appear to have been subject to rigorous experimental tests. In the absence of such data, extensive documentation of the occurrence or nonoccurrence of such nest associations in various local areas, including those where avian nest predators are common as well as those where such predators are rare or absent, would appear to be useful. The following ob-

TABLE 1

DISTANCE BETWEEN OLDSQUAW NESTS AND NEAREST OPEN WATER

Nest location	Number of nests	Distance to water (meters)		
		Mean	Median	Range
Mainland beach	3	9.0	9	8–10
Mainland tundra	9	28.6	1	0.2–200
Islands in fresh water	16	2.1	2	0.1–6.7

servations of the nest sites selected by Oldsquaws, the extent of their association with Arctic Terns, and the relationships of these associations to the more common avian predators in the Churchill region are presented here as a contribution towards such documentation.

DESCRIPTION OF NEST SITES

According to Phillips (1925), "there is nothing characteristic about the (Oldsquaw) nest or its site. It is usually near the water, though sometimes far away from it . . . and is placed under thick bushes . . . when such cover is found." Oldsquaws may nest as isolated pairs, or "practically in colonies" (op. cit., p. 362). This description applies with validity to the Oldsquaw nests observed at Churchill, where nests were found in virtually all major terrestrial areas, including (1) mainland beach, (2) mainland tundra, (3) islands in fresh-water ponds, and (4) offshore islands. The present observations, conducted during June and July of 1967 and 1968, were concerned primarily with the first three of these nest habitats; confirmation of the observations cited in Taverner and Sutton (1934) of Oldsquaws nesting on offshore islands was provided by Mr. Carroll Littlefield (pers. comm.), who counted seven Oldsquaw nests on a small island off the coast of Cape Churchill on 27 June 1968.

Although the Oldsquaw is said typically to nest along the edges of small fresh-water ponds or on islands in such ponds (Phillips, 1925; Bent, 1925), records of nests placed some distance away from the nearest open water are not uncommon. Bent (1925), for example, cited observations by Hersey of a nest placed 20 feet from the edge of a pond, and a report by Palmer of a nest 40 feet from a fresh-water pond. He further cited Ekblaw that nests are "sometimes in the grass near the pools, but more frequently . . . at considerable distances from any water" (Bent, 1925:38). At Churchill, the distances to the nearest open water were also variable, ranging from as little as 0.1 m to at least 200 m for the 28 nests measured (Table 1).

The distance between Oldsquaw nests and the nearest open water at Churchill was found to vary according to the area in which the nests were

TABLE 2

DISTANCE BETWEEN OLDSQUAW NESTS AND NEAREST ARCTIC TERN NEST

Nest location	Number of nests	Distance to nearest tern nest (meters)		
		Mean	Median	Range
Mainland beach	3	13	12	10–17
Mainland tundra	5*	72	70	18–178
Islands in fresh water	16	2.3	2	0.8–6

* Does not include three nests located in the vicinity of Arctic Terns but for which distances to tern nests were not determined, and one nest that was not in association with terns.

located (Table 1). Average distances were least on the small islands in fresh-water ponds (average for 16 nests, 2.1 m), somewhat greater along the beach (average for three nests, 9.0 m), and greatest in the mainland tundra (average for nine nests, 28.6 m). The average distance to water for the mainland tundra is skewed due to a number of extreme values well above the median distance of 1 m. Except for these extreme values on the mainland tundra, nest sites tended to be close to the shore for both fresh-water islands (median 2 m) and mainland tundra (median 1 m), and somewhat farther from water for nests located along the beach (median 9 m). These results suggest that Oldsquaws at Churchill exhibit a definite tendency to nest near the edge of water, but not exclusively so. This tendency is necessarily reinforced when small islands no more than a few meters in diameter are selected for nest sites, but may be relaxed when mainland tundra locations are selected. For nests located along the beach the minimum distance to water appeared to be set by the maximum extent of wave action at high tide.

In each of the three areas described above, Oldsquaws were found nesting in association with Arctic Terns. A similar association was also present on the small offshore island visited by Littlefield (pers. comm.). On islands in fresh-water ponds, Oldsquaw nests were found exclusively on islands that also contained Arctic Terns. In consequence, minimum distances between nests of the two species on these islands were necessarily small (average for 16 nests, 2.3 m), with none exceeding 6 m (Table 2). In the other areas, and particularly on mainland tundra, distances between Oldsquaw and Arctic Tern nests were greater, ranging up to at least 178 m (Table 2). In addition, one Oldsquaw nest was found on mainland tundra in an area that apparently lacked a local population of breeding terns. This latter finding, coupled with the greater distances between nests of the Oldsquaw and Arctic Tern on the mainland tundra (Table 2), suggests a relaxation in the tendency for association between the two species on mainland tundra compared to islands in fresh-water ponds.

It should be noted that nest hunting for Oldsquaws was concentrated in areas that contained Arctic Terns, and random sampling of large areas of habitat was not done. The high frequency of association between Arctic Terns and Oldsquaws found at Churchill may therefore be biased upwards, due to an undetermined number of Oldsquaw nests being located well away from areas containing terns. Several considerations suggest, however, that the possibility of such a bias does not negate the conclusion that an association between the species does in fact occur, especially for those nests located on islands in fresh-water ponds. As indicated above, all 16 Oldsquaw nests found on such islands were in close association with Arctic Terns. While searching for nests in these areas, many islands in addition to those found to contain tern nests were inspected, yet in no instance was an Oldsquaw nest found on an island that lacked terns. Nests located on islands in one small fresh-water pond are illustrative: In 1967, two islands in the pond each had one Oldsquaw nest and one tern nest. In 1968, one of these islands had an Arctic Tern nest and two Oldsquaw nests; the other island contained nests of neither species. From considerations such as these, coupled with the measurements listed in Table 2, it seems reasonable to conclude that a definite positive association between Oldsquaw and Arctic Tern nests was present at Churchill in 1967 and 1968. An exact determination of the frequency of this association on mainland tundra remains lacking, however, pending a more complete and random sampling of the potential nesting habitat.

AVIAN PREDATORS

At least three potential avian predators of Oldsquaw eggs were present at Churchill: Herring Gull (*Larus argentatus*), Parasitic Jaeger (*Stercorarius parasiticus*), and Common Raven (*Corvus corax*). Of these species, the Herring Gull was most common; 15 and 22 breeding pairs were found, widely scattered, throughout the study area in 1967 and 1968 respectively. In addition, mixed flocks composed largely of non-breeders of this and other large *Larus* gulls totalling several hundred in number could be observed daily at the local garbage dump located near the middle of the study area.

Egg predation of ground-nesting species by Herring Gulls is considered by some authorities to be infrequent (Bent, 1921:112). They are, however, known to take eggs of various ground-nesting species (Tinbergen, 1953), including those of the Oldsquaw (Sutton, 1932:263–264). This latter fact, coupled with the high numbers of Herring Gulls known to be present at Churchill, suggests that it would be unrealistic to exclude the Herring Gull as a potential egg predator of Oldsquaws in this region.

Although less abundant than the Herring Gull, Parasitic Jaegers and Ravens were observed throughout the area in both 1967 and 1968. Accord-

ing to Kortwright (1953:283), jaegers, along with various other predators, may "take a heavy toll" of Oldsquaw eggs. Sutton (1932) also cited the Parasitic Jaeger as a predator of Oldsquaw eggs, and cited observations of jaegers taking Oldsquaw young. The Raven, according to Larson (1960), may also constitute an important egg predator of the Oldsquaw.

Despite the presence of the above predators, loss of Oldsquaw clutches at Churchill was limited. On islands in fresh-water ponds, no predator-destroyed clutches were found in 1967, even when nests were visited repeatedly, every one to two days, by one or more observers. In 1968, two clutches, found prior to the onset of nesting by the terns, were missing on subsequent visits to the islands, and may therefore have been destroyed by predators. On the beach, one nest was destroyed within an abandoned tern colony. This loss, however, was apparently due to wave action rather than to predation. On the mainland tundra, at least two, and possibly three, nests were destroyed, presumably by predators. Taken together, these figures indicate that at most, no more than five of the 28 nests (18 per cent) were destroyed by predators. This percentage loss of clutches compares favorably with egg loss (average 22.9 per cent) of several anatid species nesting in larid colonies located on islands in the Gulf of Bothnia (Hilden, 1964), but is somewhat greater than that for Gadwall (*Anas strepera*) and Lesser Scaup (*Aythya affinis*) nesting in association with *Larus* spp. in Alberta, where 89–90 per cent of the nests hatched (Vermeer, 1968).

DISCUSSION

In the absence of comparative data from areas where egg predators are absent or where terns and Oldsquaws do not nest together, definite conclusions concerning the extent of nest protection derived by the Oldsquaws that nest in association with Arctic Terns are not warranted. Indirect evidence, however, is provided by instances in which avian predators have been attacked and driven away by Arctic Terns, as described for the Herring Gull by Sutton (1932), Bullough (1942), and Sutton and Parmelee (1956). Active defense by Arctic Terns of their nest sites against Parasitic Jaegers (Anderson, 1913; Sutton, 1932; Lovenskiold, 1954) and Ravens (Sutton, 1932; Larson, 1960) have also been documented. Instances in which Arctic Terns attacked and chased these species were also observed during the present study at Churchill. There thus seems little reason to doubt the interpretation of Anderson (1913), Larson (1960) and others that such attacks by Arctic Terns provide a measure of protection for birds that nest in or near their colonies, and that such nest associations are therefore commensal relationships. The data obtained at Churchill suggest, however, that the commensal relationship between Oldsquaws and Arctic Terns is of significance primarily for nests located on islands (cf. also Larson, 1960;

Delacour, 1959:174–175), and possibly for those located on the beach, but is probably of less importance for nests located on the mainland tundra.

The most parsimonious explanation of the proximate mechanisms underlying the association between Oldsquaws and Arctic Terns is that of similar habitat preferences by two compatible species. At Churchill, this simple interpretation would seem sufficient for nests located on the mainland tundra, where distances between nests of the two species were comparatively great, but it does not appear sufficient to account for the close association in other habitats, particularly on islands in fresh-water ponds. In these latter areas, some form of active selection of one species by the other seems likely.

According to the general hypothesis advanced by Koskimies (1957), the development of positive associations between Oldsquaws and Arctic Terns could be attributed to the active selection of tern colonies by Oldsquaws that have been imprinted, as ducklings, to terns that were present in the vicinity of their nest. At Churchill, it was evident that opportunities for auditory or visual imprinting of Oldsquaw ducklings to Arctic Terns typically occurred at hatching. The extent to which such imprinting might influence subsequent choice of nest site by the ducks remains problematical, however, in part due to the early arrival of the Oldsquaw, which may precede the arrival of the terns on the breeding grounds (Taverner and Sutton, 1934). In addition, in at least six instances in 1968, Oldsquaws at Churchill had laid clutches prior to the onset of laying by terns on the same islands.

A possible supplement to the imprinting hypothesis was suggested by observations at Churchill of Oldsquaw nest cups, remaining from previous years, on the islands in fresh-water ponds. These old nests, which numbered as high as 10 on a single island measuring no more than 10 by 5 m in size, indicate that, like the Arctic Tern (Cullen, 1956), Oldsquaws may use traditional nesting areas from year to year. Where this tendency is prevalent, then once a nesting Oldsquaw became established in or near a tern colony, association in the same area would be perpetuated in subsequent years regardless of which species commenced nesting first in any particular year. The initial association, according to this interpretation, could presumably arise either as a chance result of similar habitat preferences of the two species or as a result of imprinting.

According to evidence reviewed by Hilden (1965:68) fidelity to a traditional nest site is more likely to occur in the absence of nest disturbance or predation. If true for Oldsquaws, then nests located away from tern colonies, if destroyed by predators, would tend to be shifted to a different location in the following year, whereas those located in tern colonies, where predation is less likely, would tend to be placed in the same location in subsequent years. Such differential predation and nest site fidelity cannot therefore be excluded

as a possible additional mechanism favoring the accretion of Oldsquaw nests in or near tern colonies.

If imprinting alone constituted the proximate cause of associations between Oldsquaws and Arctic Terns, a more or less random distribution of local areas in which associations do or do not occur would be expected. In particular, it would not be expected that the occurrence of associations would necessarily be concentrated in those areas where avian nest predators are locally abundant. According to the alternative view, that associations may be initiated either by similar habitat preferences or imprinting, but are then favored by the tendency of Oldsquaws to use traditional nest sites that are protected from nest predators by Arctic Terns, maximum association in areas where nest predators are abundant would be expected. Further investigations of association between these species, with particular reference to the presence or absence of local populations of avian nest predators, should therefore provide information as to the relative importance of these various mechanisms, all of which must be considered tenable on the basis of existing data.

SUMMARY

A high incidence of nest association between Arctic Terns and Oldsquaws was found at Churchill, Manitoba, in 1967 and 1968. Distances between nests of these species averaged only 2.3 m on islands in fresh-water ponds, increased to an average of 13 m on mainland beach sites, and reached 72 m on mainland tundra.

Potential avian predators of Oldsquaw eggs included the Herring Gull, Parasitic Jaeger, and Common Raven. Clutches lost to predators did not exceed a maximum of five of 28 nests observed. Observations of Arctic Terns attacking potential predators suggested that Oldsquaws derived protection from nearby terns. It is suggested that such protection, coupled with a tendency to return to successful nest sites in successive years, affords a possible supplement to habitat preferences and imprinting of ducks to terns as the proximate mechanism responsible for the maintenance of nest associations between these species.

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